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09/427,815	10/27/1999	DAVID P. ROSSUM	17002-01400U	3803

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EXAMINER	
GRAHAM, ANDREW R	
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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/427,815	Applicant(s) ROSSUM, DAVID P.
	Examiner Andrew Graham	Art Unit 2644

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 March 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-33* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-33* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

1. **Claims 12-16** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 12 recites the limitation "the method" in the second line of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claims 13-16 are rejected due to their respective dependencies upon Claim 12.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. **Claims 1-10 and 12-31** are rejected under 35 U.S.C 103(a) as being unpatentable over Chester (USPN 5717617) in view of Adams et al

(USPN 5786778). Hereafter, "Adams et al" will be referred to as "Adams".

Chester discloses a system for using multiple stages of signal processing to increase or decrease the sampling rate of an input signal. The architecture is applicable to both decimation and interpolation, which reads on "A method for converting an input signal to one of a plurality of differing output sample rates" (col. 2, lines 23-27). Figure 7b illustrates a first interpolating or upsampling embodiment of the disclosed invention. The illustrated system operates on a digital input signal with an associated input frequency f_{IN} (col. 6, lines 50-52). This input sampling frequency of the input signal reads on "receiving, at an input sample rate, a plurality of data points, associated with the input signal". The first stage of the signal processing includes a low pass filter (LPF1), which has an associated transition band shown in Figure 8b (col. 6, lines 60-64). Figure 8c illustrates the images resulting from this filtering. The second stage of the shown processing also involves a low pass filter (LPF2) and Figure 8d (col. 7, lines 6-10). The application of either of these two filters and the shown two stages to the input signal reads on "operating on said plurality of data points to associate said input signal with a predetermined set of parameters, with said set of parameters including a first transition band having an image corresponding thereto". The third stage of the processing involves an interpolation by a factor (L_2) and a third filtering (LPF3) (col. 6, lines 56-67). The upsampling performed by the interpolation (L_2) reads

on "varying said input sample rate associated with said input signal to any one of a plurality of differing output sample rates by interpolation with an interpolator". The width of the transition band of the third filter is shown in Figure 8e (col. 7, lines 10-14). The width of this transition band can be seen in comparison with Figures 8b and 8c, which show that the transition band of the third filter (LPF3) is twice that of the first filter (LPF1), and it happens to extend up to the base of the first, non-filtered harmonic image, which is related to the stop band of the second filter. Thus, the third filter reads on "having associated therewith a second transition band, with the width associated with said second transition band being a function of a spectral separation of said first transition band and said image". The final processed signal has an adjusted frequency of F_{OUT}, which reads on "an output signal is produced having a sequence of data samples approximating the input signal" (col. 6, lines 50-55).

However, Chester does not specify:

- said output sample rate is capable of being varied to any one of said plurality of differing output sample rates for any output data sample

Adams discloses a system for a sample rate converter that continuously performs variable rate interpolation or variable rate decimation (col. 3, lines 21-23). Figure 5 illustrates a system for establishing the noise shaped clock signal used in clocking other components of the system. The Such a system receives the input signal

(56), and uses a discrete time loop filter (62), quantizer(66), and programmable clock divider (70) that is clocked by the master clock (64) to produce a noise shaped clock signal (col. 6, lines 1-13). Figure 8 illustrates a variable rate interpolation embodiment of the invention. The interpolation filter (84) receives a noise shape signal (65), which is produced by the system discussed above in regards to Figure 5 to accurately clock the input signal (col. 55-63). The error between an ideal clock and a noise shaped clock is shown in Figure 9 (col. 8, lines 50-62). The use of a noise shaped clocking signal in the interpolation reads on "said output sample rate is capable of being varied to any one of said plurality of differing output sample rates for any output data sample".

To one of ordinary skill in the art at the time of the invention, it would have been obvious to include a variable rate clock system for the clocking the interpolators and decimators of the system of Chester. The motivation behind such a modification would have been that such a system would have enabled the interpolator or decimator to accurately process the input samples in view of the variable sample rate of the input signal, taking into account an average variation in the input sample rate relative to that of a master clock. In other words, such a system allows a variant input sample to still be accurately processed with a master input clock, wherein the input sample rate is not an integer multiple of the master clock rate. The various rate changes, as shown in Figure 9, are considered herein to be the continuously varying output sample rate signals.

Regarding **Claim 2**, Chester discloses that the low pass filters are of FIR type, with 128, 140, and 128 taps, which has collectively fewer taps than traditional one stage FIR filtering (col. 5, lines 63-67 and col. 6, lines 1-9). FIR structures are well known in the art to apply coefficients to sequential values of the input sample values, as is noted by Chester (col. 4, lines 1-34). The use of these filters reads on "convolving a predetermined finite number of N data points with an equal number of coefficients, with N being greater than two".

Regarding **Claim 3**, Chester notes that the coefficients of an FIR filter, as is well known in the art, are time varying (col. 4, lines 29-31). This reads on "coefficients vary as a function of the temporal spacing between the output point and the corresponding input points".

Regarding **Claim 4**, Chester discloses an interpolation embodiment with a particular expansion rate (col. 6, lines 33-45). The overall rate change of this embodiment reads on "varying said input sample rate increases said input sample rate".

Regarding **Claim 5**, Chester discloses a decimation embodiment of the sample rate conversion system (col. 4, lines 38-40). This reads on "varying said input sample rate decreases said input sample rate".

Regarding **Claim 6**, the interpolation rate of the interpolator of the first stage of the processing shown in Figure 7b includes selectable factors (col. 6, lines 46-50). Chester discloses that the two interpolators in the shown embodiment have a combined target interpolation factor, and that the first interpolation factor is the

smaller of the two (col. 6, lines 46-50). The example given includes this factor as three, with the overall interpolation factor being 31 (col. 7, lines 15-24). These teachings, in view of a smaller potential interpolation factor, read on "upsampling said data points by a factor of two".

Regarding **Claim 7**, the width of the transition band of the first low pass filter is half of the frequency of interpolation rate (L_2) (col. 60-64). This reads on "filtering said plurality of data points with a half band filter".

Regarding **Claim 8**, the interpolation embodiment involves the use of a decimator (L_2) with the first stage low pass filter (col. 6, lines 60-67). This reads on "operating on said plurality of data points includes decimating said plurality of data points with a half-band decimator".

Regarding **Claim 9**, Chester discloses an embodiment of a rate change system in Figure 9. This embodiment can be seen to comprise a series of stages of interpolating and filtering. The third stage is disclosed as having a transition band that extends to .0838 F_1,which is the same frequency of the end of the transition band of the first low pass filter (LPF1) (col. 8, lines 19-22 and 39-40). The transition band of the filter of the first stage extends to half of an intermediate frequency (Figure 10A). The third stage, which includes decimation, thus reads on "decimating a plurality of data points output by said interpolator with a half band decimator". This stage occurs after the input of the signal to be processed, and after the

interpolation performed in the first stage, which reads on "varying said input sample rate occurring after receiving said plurality of data points and before decimating said plurality of data points" (Figure 9).

Regarding **Claim 10**, please refer to the above discussion of the parallel limitations of Claim 2, noting Chester's discussion of prior art FIR filters and the number of taps in the involved filters (col. 1, lines 40-54; col. 4, lines 27-34; col. 6, lines 1-9).

Regarding **Claim 12**, please refer to the above discussion of the parallel limitations of Claims 1 and 7, noting that Chester discloses the selection of the interpolation rate (col. 6, lines 46-50).

Regarding **Claim 13**, please refer to the above discussion regarding the parallel limitations of Claims 6 and 7, and the first stage of the processing of Chester in Figure 7b.

Regarding **Claim 14**, Chester discloses an embodiment of a rate change system in Figure 9. This embodiment can be seen to comprise a series of stages of interpolating and filtering. The second and fourth filters (LPF2, LPF4) can be seen to not involve any interpolation or decimation, and their transition bands extend to half of the relative sampling frequencies (col. 8, lines 24-26 and 50-54). This reads on "said halfband filtering is done, without upsampling, on said plurality of data points". The third and fifth stages of the system can both be seen to include interpolation, which reads on "said interpolating follows said halfband filtering".

Regarding **Claim 15**, in view of the interpolation performed in the third stage of Figure 9 of Chester, the filtering discussed in the fourth stage as discussed above in regards to Claim 16, reads on "additional halfband filtering follows said interpolating" (col. 8, lines 50-54).

Regarding **Claim 16**, the transition band in the first stage of Figure 9, which includes an upsampling part with a factor of (L_X) can be seen in Figure 10A to be half an intermediate frequency, which reads on "said halfband filtering is performed in conjunction with upsampling said plurality of data points" (col. 8, lines 13-23). The interpolation performed in the third stage reads on "said interpolating follows said halfband filtering" (Figure 9). The halfband filtering of the fourth stage, which is discussed above in regards to Claim 14, and the decimation performed in the fifth stage read on "halfband filtering and decimating follow said interpolating".

Regarding **Claim 17**, please refer to the above discussion of similar limitations in Claim 1.

Regarding **Claim 18**, please refer to the above discussion of similar limitations in Claim 6.

Regarding **Claim 19**, please refer to the above discussion of similar limitations in Claim 7.

Regarding **Claim 20**, please refer to the above discussion of similar limitations in Claim 8.

Regarding **Claim 21**, please refer to the above discussion of similar limitations in Claim 9.

Regarding **Claim 22**, please refer to the above discussion of similar limitations in Claim 10.

Regarding **Claim 23**, please refer to the above discussion of similar limitations in Claim 12, noting the storage disclosed by Chester and inherent for the digital implementation of the system (col. 9, lines 61-64).

Regarding **Claim 24**, please refer to the above discussion of similar limitations in Claim 13.

Regarding **Claim 25**, please refer to the above discussion of similar limitations in Claim 14.

Regarding **Claim 26**, please refer to the above discussion of similar limitations in Claim 15.

Regarding **Claim 27**, please refer to the above discussion of similar limitations in Claim 16.

Regarding **Claim 28**, Chester teaches the use of a weighted sum of sequential samples wherein the weighting coefficients are periodically time varying (col. 4, lines 14-22 and Figure 4c). This reads on "wherein said interpolator is an FIR Nth order sum of products interpolator with linear interpolation of coefficients".

Regarding **Claim 29**, please refer to the above discussion of similar limitations in Claim 28.

Regarding **Claim 30**, Figure 8e illustrates that the transition band of the third filter extends to the base of a harmonic image, which reads on "said interpolator has a transition band beginning adjacent the top of a passband and ending adjacent the bottom of a

passband image" (col. 7, lines 10-14).

Regarding **Claim 31**, please refer to the above discussion of similar limitations in Claim 30.

3. Claims 11, 22, 31, and 32 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Chester in view of Adams as applied above, and in further view of White (USPN 5808924).

As detailed above, Chester discloses a system for using multiple stages of interpolation, filtering, and decimation for various sample rate conversions of an input signal. Adams discloses a system for clocking an input signal at a rate consistent with the noise shaped sample rate of the input signal.

However, Chester in view of Adams does not specify:

- that the involved filters are infinite impulse response filters

White discloses a decimating IIR filter. This filter involves an integrate and dump circuit (50) and a output loop (52) (col. 4, lines 33-36). The integrate and dump circuit involves a single feedback loop connected through an adder that involves a delay element (col. 4, lines 39-48). The output loop involves a multiplying element and a delay element (col. 4, lines 49-59). This overall combined system, shown in Figure 4, reads on "filtering the same with an infinite impulse response filter".

To one of ordinary skill in the art at the time the invention was made, it would have been obvious it would have been obvious to utilize

the IIR decimating filter in the processing stages discussed above in the system of Chester in view of Adams. The motivation behind such a modification would have been that such an IIR filters would have required fewer components and circuitry than the multi-tap FIR filters of Chester in view of Adams. IIR filters are also well known in the art to involve more input samples in the signal adjustment process than FIR filters.

Regarding **Claim 22,** please refer to the above discussion of similar limitations in Claim 11.

Regarding **Claim 32,** the system of White utilizes first order all-pass sections, which, in view of the filtering of Chester, reads on "said halfband filter is an IIR filter composed on first order allpass blocks" (col. 2, lines 20-22 and col. 3, lines 29-33).

Regarding **Claim 33,** please refer to the above discussion of similar limitations in Claim 32.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Jiang et al (USPN 6487573 B1) also discloses a multi-rate digital filter for audio sample conversion that involves a plurality of interpolation filtering stages. The filters for Jiang et al are taught to be either FIR or IIR filters and halfband filtering is specifically noted (col. 4, lines 19-24 and col. 8, lines 4-11 and 47-51).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew Graham whose telephone number is 703-308-6729. The examiner can normally be reached on Monday-Friday, 8:30 AM to 5:00 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bill Isen can be reached on (703)305-4386. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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May 17, 2004